ФГБОУ ВО «Воронежский государственный технический университет»

СПРАВОЧНИК ЭЛЕКТРОННОГО ИЗДАНИЯ

Строительно-политехнический колледж

106-2023

АВТОМАТИЗИРОВАННОЕ ПРОИЗВОДСТВО

МЕТОДИЧЕСКИЕ УКАЗАНИЯ

к практическим занятиям и самостоятельной работе
по дисциплине «Иностранный язык в профессиональной деятельности (английский)»
для студентов 4 курса специальности
15.02.10 Мехатроника и мобильная робототехника (по отраслям)

Часть 1

Составители:
Аленькова Наталья Валерьевна
Полухина Ирина Васильевна
Прибыткова Ольга Васильевна
Малютина Юлия Владимировна

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РОССИЙСКОЙ ФЕДЕРАЦИИ

Федеральное государственное бюджетное образовательное
учреждение высшего образования
«Воронежский государственный технический университет»

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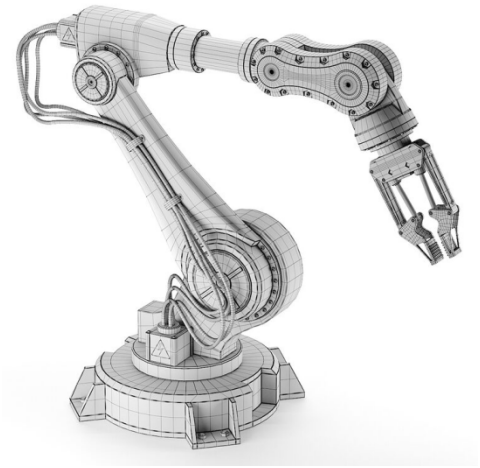

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Составители: преп. Н. В. Аленькова,
преп. И. В. Полухина,
преп. О. В. Прибыткова,
преп. Ю. В. Малютина,

Автоматизированное производство: методические указания к практическим занятиям и самостоятельной работе по дисциплине «Иностранный язык в профессиональной деятельности (английский язык)» для студентов 4 курса специальности 15.02.10 Мехатроника и мобильная робототехника (по отраслям). Часть 1 / ФГБОУ ВО «Воронежский государственный технический университет»; сост.: Н. В. Аленькова, И. В. Полухина, О. В. Прибыткова, Ю. В. Малютина. Воронеж, Изд-во ВГТУ, 2023. 31 с.

Методические указания содержат учебные тексты и задания для аудиторной и внеаудиторной работы студентов. Они предназначены для развития навыков чтения, реферирования и аннотирования литературы по специальности, а также для развития навыков говорения и расширения терминологической лексики. Задания содержат упражнения на усвоение лексических единиц по специальности.

Методические указания предназначены для студентов 4 курса специальности 15.02.10 Мехатроника и мобильная робототехника (по отраслям) строительно-политехнического колледжа продолжающих изучение английского языка для профессиональных целей в соответствии с ФГОС СПО.

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Рецензент - А. А. Падурец, канд. филол. наук, доц. кафедры иностранных языков и технологии перевода ВГТУ

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UNIT 1

МЕХАНИКА – РАЗДЕЛ ФИЗИКИ

1. Изучите следующие слова и словосочетания:

1. science – наука,
2. nature – природа,
3. to exist – существовать,
4. vast - громадный, многочисленный,
5. matter – вещество,
6. carefully – внимательно,
7. various - различный, разный; многочисленный,
8. to occur – встречаться,
9. nuclear – ядерный,
10. in addition to - в добавление к,
11. distinct – отдельный,
12. to merge – сливаться,
13. to deal with - иметь дело,
14. primarily - первоначально, сперва,
15. knowledge – знание,
16. relative to – относящийся к,
17. motion- движение,
18. scientist – ученый,
19. velocity - скорость.

2. Прочитайте текст. Расскажите, что изучает механика и каким образом она взаимосвязана с физикой:

TEXT 1

PHYSICS GIVES WAY TO MECHANICS

Physics is one of the most ancient sciences about nature. The word "physics" takes its origin from the Greek word "phew-sis" meaning nature. Physics is the science studying various phenomena in nature: mechanical motion, heat, sound, electricity, magnetism and light. Physics is one of the main sciences about nature. The development of other sciences depends in many respects on the knowledge of physical phenomena.

Physics is divided into two great branches, experimental physics and theoretical physics. The first is the science of making observations and devising experiments, which give us accurate knowledge of the actual behaviour of natural phenomena. On the basis of experimental facts theoretical physics formulates laws and predicts the behaviour of natural phenomena. Every physical law is based on

experiments and is devised to correlate and to describe accurately these experiments. The wider the range of experience covered by such a law, the more important it is.

Physics is divided into half a dozen or more different fields - mechanics, sound, heat, electricity and magnetism, light, molecular, atomic and nuclear physics. These different fields are not distinct but merge into each other.

Mechanics (from Ancient Greek: μηχανική, mēkhanikḗ, lit. "of machines") is the area of mathematics and physics concerned with the relationships between force, matter, and motion among physical objects. Forces applied to objects result in displacements, or changes of an object's position relative to its environment.

Theoretical expositions of this branch of physics had its origins in Ancient Greece, for instance, in the writings of Aristotle and Archimedes. During the early modern period, scientists such as Galileo, Kepler, Huygens, and Newton laid the foundation for what is now known as classical mechanics.

As a branch of classical physics, mechanics primarily deals with bodies that are either at rest or are moving with velocities significantly less than the speed of light. It can also be defined as the physical science that deals with the motion of and forces on bodies not in the quantum realm.

Historically, classical mechanics had been around for nearly a quarter millennium before quantum mechanics developed. Classical mechanics originated with Isaac Newton's laws of motion in Philosophiæ Naturalis Principia Mathematica, developed over the seventeenth century. Quantum mechanics developed later, over the nineteenth century, precipitated by Planck's postulate and Albert Einstein's explanation of the photoelectric effect. Both fields are commonly held to constitute the most certain knowledge that exists about physical nature.

Classical mechanics has especially often been viewed as a model for other so-called exact sciences. Essential in this respect is the extensive use of mathematics in theories, as well as the decisive role played by experiment in generating and testing them.

Quantum mechanics is of a bigger scope, as it encompasses classical mechanics as a sub-discipline which applies under certain restricted circumstances. According to the correspondence principle, there is no contradiction or conflict between the two subjects, each simply pertains to specific situations.

Often cited as father to modern science, Galileo brought together the ideas of other great thinkers of his time and began to calculate motion in terms of distance travelled from some starting position and the time that it took. He showed that the speed of falling objects increases steadily during the time of their fall. This acceleration is the same for heavy objects as for light ones, provided air friction (air resistance) is discounted. The English mathematician and physicist Isaac Newton improved this analysis by defining force and mass and relating these to acceleration. For objects traveling at speeds close to the speed of light, Newton's laws were superseded by Albert Einstein's theory of relativity. For atomic and subatomic particles, Newton's laws were superseded by quantum theory. For everyday phenomena, however, Newton's three laws of motion remain the cornerstone of dynamics, which is the study of what causes motion.

3. Переведите следующие слова и словосочетания. Составьте 6 – 8 предложений с любыми данными словами и словосочетаниями:

phenomenon - phenomena, nature, natural, to depend on (upon), knowledge, theory, theoretical, observation, to devise, accurate, to formulate, law, to predict, to base, on the basis of, to correlate, distinct, to merge, to deal with, primarily, in terms of, matter, hence, therefore, concept, to determine, characteristics, to govern, transformation, to exist.

4. Ответьте на следующие вопросы:

1. What is physics?
2. What phenomena does physics study?
3. From what language does the word "physics" take its origin?
4. Does the development of other sciences depend on the knowledge of physical phenomena?
5. What is experimental physics?
6. What is theoretical physics?
7. What are all physical laws based on?
8. What are the basic concepts in all physical phenomena?
9. What fields is physics divided into?
10. What is mechanics?
11. What do you know about quantum mechanics?
12. Who laid the foundation for what is now known as classical mechanics?

5. Составьте реферат текста, используя следующие выражения:

1. The title of the text is “...”.
2. It is taken from the book “…” written by…
3. The text can be divided into … logical parts.
4. The first part/ paragraph tells us about...
5. From the second part we learn about...
6. The third part is devoted to/ gives information about/ deals with/ describes/ gives some facts about/ contains information about...
7. The main idea of the text is …
8. I can say that the text is …, which is very useful for our future professional activity.

UNIT 2

ИСТОРИЯ ПОЯВЛЕНИЯ АВТОМАТИЗАЦИИ В ПРОМЫШЛЕННОСТИ

1. Изучите следующие слова и словосочетания:

1. ancestor – предок, прародитель
2. to assemble – собирать, монтировать; assembly – сборка; узел; агрегат
3. data – данные; информация
4. to develop – создавать; развивать; совершенствовать; разрабатывать; development – развитие; сооружение; разработка; усовершенствование
5. engine – машина; двигатель; steam engine – паровая машина; analytical engine – аналитическая машина
6. to evolve – эволюционировать, развиваться
7. extension – расширение; распространение; продолжение
8. lever – рычаг, рукоятка
9. loom – ткацкий станок
10. to magnify – увеличивать; усиливать
11. muscle – мускул; сила
12. pattern – рисунок, узор; образец
13. precursor – предшественник; предвестник
14. pulley – блок; шкив
15. to punch – пробивать; перфорировать
16. technology – технология; техника; технические средства; automation technology – автоматизированная техника; технические средства автоматизации
17. trip-hammer – рычажный молот
18. wheel – колесо, маховик

2. Завершите предложения подходящими словами и словосочетаниями:

1. Simple mechanical devices, such as the wheel, the lever and the pulley…

    a) did not require strength to operate.
    b) were made of stone.
    c) magnified the power of human muscle.

2. The first trip-hammers powered by water operated in…

    a) China.
    b) Greece.
    c) France.

3. The device that marked the beginning of the Industrial Revolution was…

    a) the windmill.
    b) the steam engine.
    c) the mechanical clock.

4. The Jacquard loom, one of the first concepts of a programmable machine, was designed…

    a) in 1335.
    b) more than 2000 years ago.
    c) at the beginning of the XIX century.

5. Charles Babbage, an English mathematician, proposed a device that was the ancestor of…

    a) the computer.
    b) the telephone.
    c) the telegraph.

3. Прочитайте текст и переведите его со словарем:

TEXT 2

HISTORICAL DEVELOPMENT OF AUTOMATION

The technology of automation has evolved from the related field of mechanization, which had its beginnings in the Industrial Revolution. Mechanization refers to the replacement of human (or animal) power with mechanical power of some form. The driving force behind mechanization has been humankind's propensity to create tools and mechanical devices. Some of the important historical developments in mechanization and automation leading to modern automated systems are described here.

The first tools made of stone represented prehistoric man's attempts to direct his own physical strength under the control of human intelligence. Thousands of years were undoubtedly required for the development of simple mechanical devices and machines such as the wheel, the lever, and the pulley, by which the power of human muscle could be magnified.

The next extension was the development of powered machines that did not require human strength to operate. Examples of these machines include waterwheels, windmills, and simple steam-driven devices. More than 2,000 years ago the Chinese developed trip-hammers powered by flowing water and waterwheels. The early Greeks experimented with simple reaction motors powered by steam. The mechanical clock, representing a rather complex assembly with its own built-in power source (a weight), was developed about 1335 in Europe. Windmills with mechanisms for

automatically turning the sails were developed during the Middle Ages in Europe and the Middle East. The steam engine represented a major advance in the development of powered machines and marked the beginning of the Industrial Revolution. During the two centuries since the introduction of the Watt steam engine, powered engines and machines have been devised that obtain their energy from steam, electricity, and chemical, mechanical, and nuclear sources.

Another important development in the history of automation was the Jacquard loom, which demonstrated the concept of a programmable machine. About 1801 the French inventor Joseph-Marie Jacquard devised an automatic loom capable of producing complex patterns in textiles by controlling the motions of many shuttles of different coloured threads. The selection of the different patterns was determined by a program contained in steel cards in which holes were punched. These cards were the ancestors of the paper cards and tapes that control modern automatic machines. The concept of programming a machine was further developed later in the 19th century when Charles Babbage, an English mathematician, proposed a complex, mechanical “analytical engine" that could perform arithmetic and data processing. Although Babbage was never able to complete it, this device was the precursor of the modern digital computer.

4. Подберите к русским словам английские эквиваленты:

1. сила	a. to direct
	b. advance
2. управлять	c. power
	d. to control
	e. development
3. усовершенствование	f. force
	g. to operate
	h. strength

5. Найдите в тексте английские эквиваленты к следующим словосочетаниям:

1. паровая машина, 2. исторические достижения, 3. промышленная революция, 4. сложная конструкция (агрегат), 5. следующий шаг, 6. важное достижение, 7. источник ядерной энергии, 8. обработка информации, 9. паровой двигатель, 10. предшественник цифровой вычислительной машины.

6. Найдите 9 названий механизмов (устройств, приборов, инструментов, станков), о которых упоминается в тексте:

t	**r**	**i**	**p**	**h**	**a**	**m**	**m**	**e**	**r**
g	**m**	**e**	**w**	**l**	**o**	**d**	**y**	**p**	**a**
h	**o**	**j**	**i**	**w**	**k**	**j**	**i**	**u**	**q**
v	**t**	**i**	**n**	**h**	**t**	**o**	**o**	**l**	**n**
l	**o**	**w**	**d**	**g**	**k**	**p**	**m**	**l**	**r**
t	**r**	**i**	**m**	**h**	**a**	**m**	**m**	**e**	**r**
l	**n**	**e**	**i**	**f**	**b**	**s**	**t**	**y**	**c**
o	**o**	**o**	**l**	**e**	**v**	**e**	**r**	**d**	**f**
o	**p**	**d**	**l**	**e**	**l**	**c**	**a**	**m**	**b**
m	**x**	**y**	**z**	**e**	**n**	**g**	**i**	**n**	**e**
w	**a**	**t**	**e**	**r**	**w**	**h**	**e**	**e**	**l**

7. Заполните пропуски подходящими по смыслу словами:

***a. engine, b. power, c. devices, d. water, e. computer, f. mechanisms, g. assembly, h. machine*.**

1. Mechanization refers to the replacement of human … with mechanical power.
2. Simple mechanical … were replaced by powered machines.
3. The Chinese developed trip-hammers powered by flowing …
4. The mechanical clock represented a complex … with its own built-in power source.
5. Windmills had … for automatical turning the sails.
6. The Watt steam … marked the beginning of the Industrial Revolution.
7. The Jacquard loom demonstrated the concept of a programmable … .
8. The “analytical engine” proposed by Charles Babbage was the precursor of the modern digital…

8. Заполните пустые ячейки на рис. 1.1, используя информацию из текста:

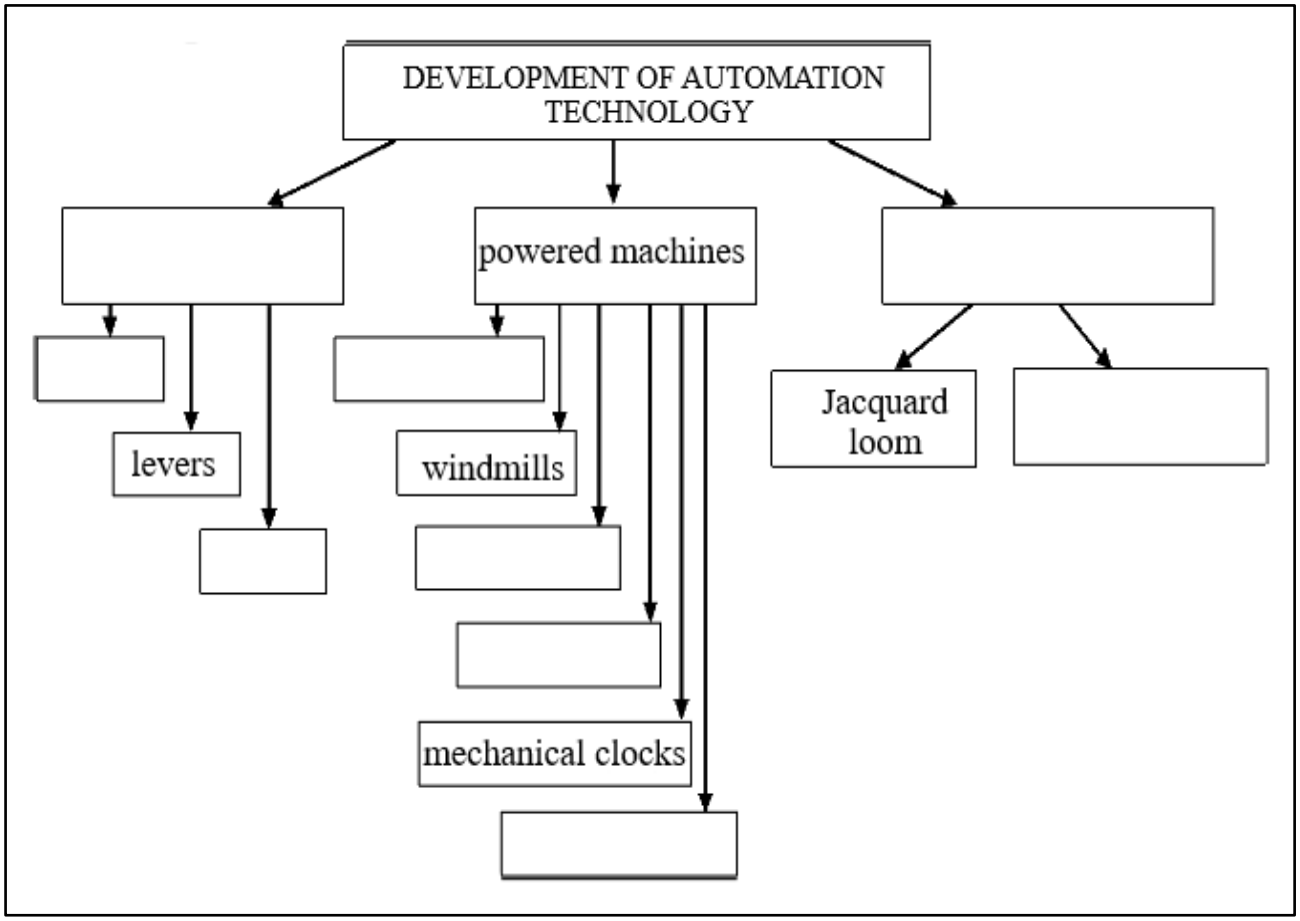

Рис. 1.1. Схема-спайдограмма развития автоматизированного производства

9. Расскажите, что вы узнали об истории развития автоматизированного производства, используя план из упражнения 6 Unit 1 и сведения из рис. 1.1.

UNIT 3

РАЗВИТИЕ МЕХАНИЧЕСКОЙ ИНЖЕНЕРИИ

1. Изучите следующие слова и словосочетания:

1. *to mount on an axle – установить на ось;*
2. *a sophisticated device/ machine – сложное устройство/ машина/ станок;*
3. *an enormous impetus – значимый импульс;*
4. *to receive formal recognition – получить официальное признание;*
5. *machinery – механическое оборудование;*
6. *mechanical engineering – машиностроение, механическая инженерия;*
7. *research – исследование*;

8. *to evolve – развиться, выделиться из;*
9. *trial and error – метод проб и ошибок;*
10. *a quality – качество;*
11. *to obtain high rates of production – получить высокие темпы производства;*
12. *accuracy and complexity – точность и сложность;*
13. *to owe – быть должным, обязанным чему-либо;*
14. *a requirement – требование;*
15. *to be closely integrated with – быть тесно связанным с;*
16. *a manufacturing process – производственный процесс;*
17. *a versatile machine tool – универсальный станок.*

2. Переведите предложения с русского на английский:

1. На заводе следят за высоким качеством выпускаемых товаров.
2. Важно помнить, что при производстве этой детали требуется дорогое механическое оборудование.
3. Роботы-пылесосы набирают высокие темпы производства благодаря повышенному спросу.
4. Мой брат изучает основы механической инженерии в колледже.
5. Механика тесно связана с математикой и программированием, но обязана своим появлением, в первую очередь, физике.
6. Сложность производственного процесса и высокая точность тормозят массовый выпуск роботизированных автомобилей.
7. Стиральная машина представляет собой сложное механическое устройство.
8. Исследование показало, что проблемы, связанные с автоматизацией производства, представляют для студентов особый интерес.
9. Студенты изготовили программируемый замок методом проб и ошибок.

3. Прочитайте текст и переведите его со словарем:

TEXT 3

FROM THE HISTORY OF MECHANICAL ENGINEERING

Mechanical engineering is one of the oldest branches of engineering, dating back to when the first wheels were put to practical use by mounting them on an axle to make a cart. Throughout recorded history, people have been inventing and building increasingly more sophisticated devices and machines in order to improve their life conditions. Many of the machines we encounter every day - cars, appliances, tools and climate control systems - were made possible by mechanical engineers.

"Mechanical engineering dates to ancient Greece and China, where mechanisms like screw pumps, steam engines, clocks, seismometers and even

differential gears were invented," according to the American Society of Mechanical Engineers (ASME). Pioneers in the field - people who built the machines for which they became famous - include Archimedes (Archimedes' screw pump, block-and-tackle pulley, etc.), Johannes Gutenberg (movable-type printing press), James Watt (steam engine), Robert Fulton (steamboat), Eli Whitney (cotton gin) and Henry Ford (automobile assembly line).

It is well-known that the invention of the steam engine in the latter part of the 18th century, providing a key source of power for the Industrial Revolution, gave an enormous impetus to the development of machinery of all types. As a result, a new major classification of engineering dealing with tools and machines developed, receiving formal recognition in 1847 in the founding of the Institution of Mechanical Engineers in Birmingham, England.

Mechanical engineering has evolved from the practice by the mechanic of an art based largely on trial and error to the application by the professional engineer of the scientific method in research, design, and production. The demand for increased efficiency is continually raising the quality of work expected from a mechanical engineer and requiring a higher degree of education and training.

Nowadays, the high standard of living in the developed countries owes much to mechanical engineering. The mechanical engineer invents machines to produce goods and develops machine tools of increasing accuracy and complexity to build the machines.

The principal lines of development of machinery have been an increase in the speed of operation to obtain high rates of production, improvement in accuracy to obtain quality and economy in the product, and minimization of operating costs. These three requirements have led to the evolution of complex control systems.

The most successful production machinery is that in which the mechanical design of the machine is closely integrated with the control system. A modern transfer (conveyor) line for the manufacture of automobile engines is a good example of the mechanization of a complex series of manufacturing processes.

Developments are in hand to automate production machinery further, using computers to store and process the vast amount of data required for manufacturing a variety of components with a small number of versatile machine tools.

4. Ответьте на вопросы:

1. What is mechanical engineering?
2. What was a reason that people were inventing and building increasingly more sophisticated devices and machines?
3. What ancient mechanisms do you know?
4. What gave an enormous impetus to the development of machinery of all types?
5. When was the Institution of Mechanical Engineers in Birmingham founded?
6. What is expected from a mechanical engineer?
7. What helps to obtain high rates of production?

8. What production machinery can be called the most successful?
9. What examples of the mechanization of a complex series of manufacturing processes can you name?
10. How are computers used to automate production machinery?

5. Расскажите, что вы узнали об истории развития механической инженерии, используя план из упражнения 6 Unit 1.

UNIT 4

АВТОМАТИЗАЦИЯ

1. Изучите следующие слова и словосочетания:

1. to accomplish – выполнять; завершать
2. to weld – сваривать; weld – сварной шов; to spot weld – осуществлять точечную сварку; weld spot – сварная точка
3. arm – механическая рука; рычаг; рукоятка
4. to attribute – приписывать, относить
5. body – корпус
6. to define – определять, давать определение; definition – определение
7. to ensure – обеспечивать; гарантировать
8. to execute – выполнять; исполнять; execution – выполнение; исполнение
9. feedback – обратная связь; feedback control – управление с обратной связью; автоматическое регулирование с обратной связью
10.to intervene – вмешиваться; intervention – вмешательство; посредничество
11.to load – загружать; закладывать; to unload – выгружать; разгружать
12.to mature – созревать
13.to mean – значить, означать; means – средство; способ; by means of – посредством
14.to surpass – превосходить, превышать
15.sequence – последовательность; чередование; цикл
16.production line – поточная линия
17.to relate – относиться; быть связанным с ...; computer-related – связанный с применением компьютера
18.robot – робот; автоматический манипулятор; robotics – робототехника

2. Дайте нижеперечисленным словосочетаниям английские эквиваленты. Выберите 5 любых словосочетаний и составьте предложения с ними:

1. важные разработки, 2. соответствующие вычисления, 3. интегральные схемы, 4. выполнять расчёты, 5. многоконтурное устройство, 6.

запоминающая среда, 7. языки программирования, 8. измерительные приборы, 9. система управления с обратной связью, 10. электромеханические контактные датчики, 11. машинное зрение, 12. сенсорные системы, 13. обработка информации, 14. линейные простые дифференциальные уравнения, 15. умственные способности, 16. искусственный интеллект.

3. Подберите к каждому слову из левой колонки определение:

1. Automation	a. The use of computers to control a particular process often by means of the replacement of employees.
2. Robotics	b. The science and technology relating to computer-controlled mechanical devices such as the automated tools commonly found on automobile assembly lines.
3. Mechanization	c. The replacement of human muscle by mechanical power.

4. Прочитайте текст и переведите со словарем:

TEXT 4

AUTOMATION TECHNOLOGY

Automation is the application of machines to tasks once performed by human beings or, increasingly, to tasks that would otherwise be impossible. Although the term “mechanization” is often used to refer to the simple replacement of human labour by machine, automation generally implies the integration of machines into a self-governing system. Automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.

The term “automation” was coined in the automobile industry (about in 1946) to describe the increased use of automatic devices and controls in mechanized production lines. The origin of the word is attributed to D.S. Harder, an engineering manager at the Ford Motor Company at the time. The term is used widely in a manufacturing context, but it is also applied outside manufacturing in connection with a variety of systems in which there is a significant substitution of mechanical, electrical, or computerized action for human effort and intelligence.

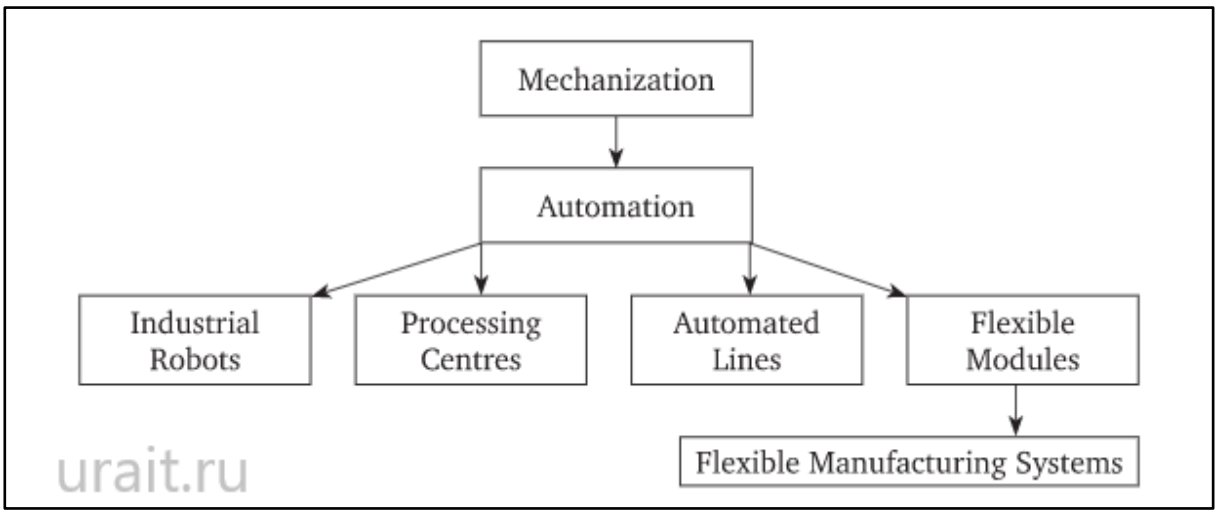

Рис. 1.2. Механизация: основные компоненты

In general usage, automation can be defined as a technology concerned with performing a process by means of programmed commands combined with automatic feedback control to ensure proper execution of the instructions. The resulting system is capable of operating without human intervention. The development of this technology has become increasingly dependent on the use of computers and computer-related technologies. Consequently, automated systems have become increasingly sophisticated and complex. Advanced systems represent a level of capability and performance that surpass in many ways the abilities of humans to accomplish the same activities.

Automation technology has matured to a point where a number of other technologies have developed from it and have achieved recognition and status of their own. Robotics is one of these technologies; it is a specialized branch of automation in which the automated machine possesses certain anthropomorphic, or humanlike, characteristics. The most typical human like characteristic of a modern industrial robot is its powered mechanical arm. The robot's arm can be programmed to move through a sequence of motions to perform useful tasks, such as loading and unloading parts at a production machine or making a sequence of spot-welds on the sheet-metal parts of an automobile body during assembly. As these examples suggest, industrial robots are typically used to replace human workers in factory operations.

Moreover, artificial intelligence plays an important role in the automation process. This advanced field of computer science helps to program the computer of a robot to exhibit characteristics commonly associated with human intelligence. These characteristics include the capacity for learning, understanding languages, reasoning, solving problems, rendering expert diagnoses, and similar mental capabilities. The developments in artificial intelligence are expected to provide robots and other "intelligent" machines with the ability to communicate with humans and to accept very high-level instructions rather than the detailed step-by-step programming statements typically required of today's programmable machines. For example, a robot of the future endowed with artificial intelligence might be capable of accepting and executing the command "assemble the product." Present-day industrial robots

must be provided with a detailed set of instructions specifying the locations of the product's components, the order in which they are to be assembled, and so forth

5. Выберите правильный ответ:

1. Mechanization is often used to refer to the simple replacement of …

a) human labour by machine.
b) mechanical power by human operators.
c) machine tools by robotic systems.

2. The term “automation” was first used …

a) in the computer industry.
b) in the robot industry.
c) in the automobile industry.

3. Any automated system is capable of operating…

a) under human control.
b) without human intervention.

4. Robot is a mechanical device that…

a) looks like a human being.
b) possesses human-like characteristics.
c) performs a variety of complex technical tasks.

6. Ответьте на вопросы:

1. What does the term “automation” mean?
2. What is the difference between automation and mechanization?
3. When was the term “automation” coined?
4. Whose name is the origin of the word “automation” attributed to?
5. What is the definition of automation?
6. What does the development of automation technology depend on?
7. What advanced technology has developed from automation technology?
8. What are the main characteristics of industrial robotics?
9. What is the most typical human like characteristic of an industrial robot?
10. What operations can the robot’s arm be programmed for?
11. What is the main purpose of industrial robots?

7. Переведите текст 4А письменно:

TEXT 4A

AUTOMATION IN INDUSTRY

Many industries are highly automated or use automation technology in some part of their operation. In communications and especially in the telephone industry dialing and transmission are all done automatically. Railways are also controlled by automatic signaling devices, which have sensors that detect carriages passing a particular point. In this way the movement and location of trains can be monitored.

Not all industries require the same degree of automation. Sales, agriculture, and some service industries are difficult to automate, though the agriculture industry may become more mechanized, especially in the processing and packaging of foods. The automation technology in manufacturing and assembly is widely used in car and other consumer product industries. Nevertheless, each industry has its own concept of automation that answers its particular production needs.

8. **Составьте реферат текста, используя план из упражнения 6 Unit 1.**

UNIT 5

ОСНОВНЫЕ ПРИНЦИПЫ АВТОМАТИЗАЦИИ

1. Изучите слова и выражения:

1. available – имеющийся в распоряжении
2. delivery – доставка; передача
3. to entail – влечь за собой; вызывать
4. entity – объект; категория
5. to exhibit – демонстрировать; проявлять
6. fuel – топливо; fossil fuel – органическое топливо
7. location – местоположение; размещение; ячейка
8. molding – формовка, формование; отливка
9. positioning – размещение, определение местоположения
10. product – изделие
11. readily – легко; быстро
12. shaping – придание формы, формование; фасонирование
13. to transfer – переносить, перемещать; передавать; transfer – перенос, перемещение; передача
14. unit – блок; узел; установка; агрегат; устройство
15. valuable – ценный; полезный
16. versatile – многосторонний; гибкий

2. **Прочитайте текст, переведите и расскажите о трех самых важных составляющих процесса автоматизации:**

TEXT 5

PRINCIPLES AND THEORY OF AUTOMATION

The developments described above have provided the three basic building blocks of automation:

(1) a source of power to perform some action,

(2) feedback controls,

(3) machine programming.

Almost without exception, an automated system will exhibit all these elements.

An automated system is designed to accomplish some useful action, and that action requires power. There are many sources of power available, but the most commonly used power in today's automated systems is electricity. Electrical power is the most versatile, because it can be readily generated from other sources (e.g., fossil fuel, hydroelectric, solar, and nuclear) and it can be readily converted into other types of power (e.g., mechanical, hydraulic, and pneumatic) to perform useful work. In addition, electrical energy can be stored in high-performance, long-life batteries.

The actions performed by automated systems are generally of two types: (1) processing and (2) transfer and positioning.

In the first case, energy is applied to accomplish some processing operation on some entity. The process may involve the shaping of metal, the molding of plastic, the switching of electrical signals in a communication system, or the processing of data in a computerized information system. All these actions entail the use of energy to transform the entity (e.g., the metal, plastic, electrical signals, or data) from one state or condition into another, more valuable state or condition.

The second type of action – transfer and positioning – is most readily seen in automated manufacturing systems designed to perform work on a product. In these cases, the product must generally be moved (transferred) from one location to another during the series of processing steps. At each processing location accurate positioning of the product is generally required. In automated communications and information systems the terms “transfer” and “positioning” refer to the movement of data (or electrical signals) among various processing units and the delivery of information to output terminals (printers, video display units, etc.) for interpretation and use by humans.

3. **Ответьте на вопросы:**

1. What are the main elements of automation?
2. What is the most commonly used power in today's automated systems?
3. In what devices can electrical energy be stored?
4. What actions can automated systems perform?

4. Составьте реферат текста, используя план из упражнения 6 Unit 1.

5. Заполните пропуски подходящими по смыслу словами:

a. action, b. elements, c. terminals, d. power, e. converted, f. sources, g. transfer.

1. Any automated system has three basic … .
2. Any useful action accomplished by an automated system requires … .
3. Electrical power can be generated from different … .
4. Electrical power can be ... into mechanical power.
5. Automated systems perform two types of … .
6. The term "…" refers to the movement of data.
7. The processed information is delivered to output … .

6. Прочитайте текст 5A и передайте его содержание на английском языке:

TEXT 5A

ОСНОВНЫЕ ЭЛЕМЕНТЫ АВТОМАТИЗИРОВАННОЙ СИСТЕМЫ

Любая автоматизированная система имеет три основных элемента: источник энергии, управление с обратной связью, программирование машины (станка). Каждая автоматизированная система требует источника питания.

Существуют разные источники питания, но наиболее универсальным источником является электроэнергия. Электроэнергию можно получить из органического топлива; из гидравлической, солнечной и ядерной энергии. В свою очередь, её можно преобразовать в механическую, пневматическую, тепловую и другие виды энергии для выполнения полезной работы. Кроме того, электроэнергия может накапливаться в долговечных батареях.

Действия, выполняемые автоматизированными системами, заключаются в обработке, перемещении и расположении. В автоматизированных коммуникационно-информационных системах данные перемещаются от одного блока обработки к другому, и полученная информация выводится на терминалы.

7. Расскажите, что вы узнали об автоматизации, используя план из упражнения 6 Unit 1

UNIT 6

МЕХАТРОНИКА

1. Изучите следующие слова и словосочетания:

1. multi- disciplinary – междисциплинарный;
2. to be coined by – быть придуманным;
3. diverse – разнообразный;
4. to involve – касаться, затрагивать, вовлекать;
5. intelligent – умный, отличающийся интеллектом;
6. to be incorporated into – быть включенным в;
7. to be featured in – быть представленным в;
8. consumer products - потребительские товары;
9. achievement – достижение;
10. delivery – доставка;
11. refined approach – усовершенствованный подход.

2. Прочитайте эти слова и словосочетания и догадайтесь о их значении:

Mechatronics, engineer, mechanical and electrical products and systems, telecommunications, control, electronics, robotics, design, mechanics, technical specialties, disciplines, programming, automobiles, replicate human actions, software, sensors and instruments, limitations, aviation.

3. Прочитайте текст и переведите:

TEXT 6

WHAT IS MECHATRONIC ENGINEERING?

Mechatronics, which is also referred to as mechatronic engineering, is a multidisciplinary field of engineering that concentrates on the engineering of both mechanical and electrical products and systems, and also involves the merging of electronics, robotics, computer, systems, telecommunications, product and control engineering. The term “mechatronics” was coined by Tetsuro Mori, the senior engineer of the Japanese company Yaskawa in 1969. An industrial robot is a prime example of a mechatronics system; it includes aspects of electronics, mechanics, and computing to do its day-to-day jobs.

Technology has continued to advance as time passes, and many sub-fields of engineering have been successful in both multiplying and adapting. The aim of mechatronics is to create a design solution that utilizes each of these diverse

subfields. At the beginning, the mechatronics field was supposed to be no more than a merging of electronics and mechanics, which is the reason why the name is a combination of the two words. However, as the technical systems became more complicated and continued to progress, the definition has been changed to involve the more technical specialties.

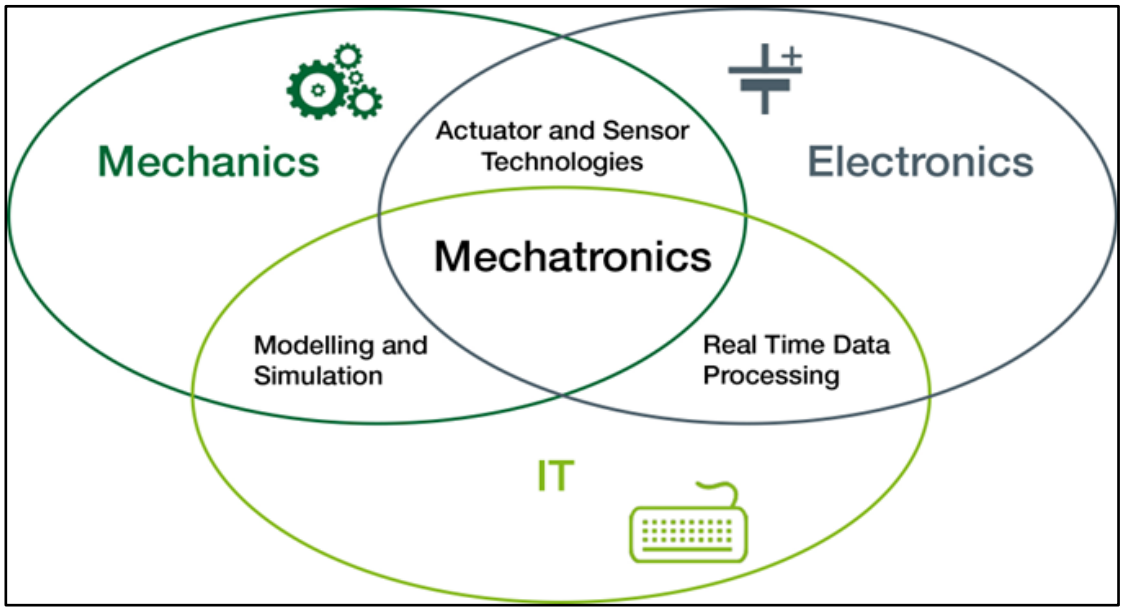

Рис. 1.3. Взаимосвязь мехатроники с механикой, электроникой и программированием

Mechatronics is a branch of engineering that focuses on designing, creating, and maintaining intelligent machines that have both mechanical and electronic components. It has been incorporated into a variety of other disciplines, including computer engineering, systems engineering, and programming. It is used in sectors like electrical engineering, advanced manufacturing, and mechanical systems (См. рис. 1.2.). A good example of mechatronics is today's automobiles. Robotics is another example, producing robots that substitute or replicate human actions using electronic parts that respond to the commands of central computer software.

Mechatronics holds an important place in today's world. It is featured in a wide range of consumer products and has many other applications, including those listed below:

1) *Factory automation*. Mechatronics engineering is used to create devices that allow factory production of goods. Control systems for packaging or bottling food and drink products are all made with mechatronics engineering.

2) *Drones.* Drones are a perfect example of the achievements made possible by mechatronics. They are a blend of mechanical and electrical engineering that have been applied in many new sectors in recent decades. From product delivery to military operations, drones now play an important role in our society.

3) *Aviation*. Mechatronics is also used in aerospace and aviation. It provides us with new, refined approaches to aviation tasks.

4) *Robotics.* The field of advanced robotics has fewer limitations thanks to mechatronics. Mechatronics has led to the creation of new sensors and instruments that have wide uses in robotics.

4. Рассмотрите ассоциативную эмблему (рис. 1.4.) и расскажите что входит в понятие “Мехатроника”. Расскажите о разделах, которые она в себя включает, для каких целей используется. Расскажите какой раздел мехатроники интересует лично вас, объясните почему:

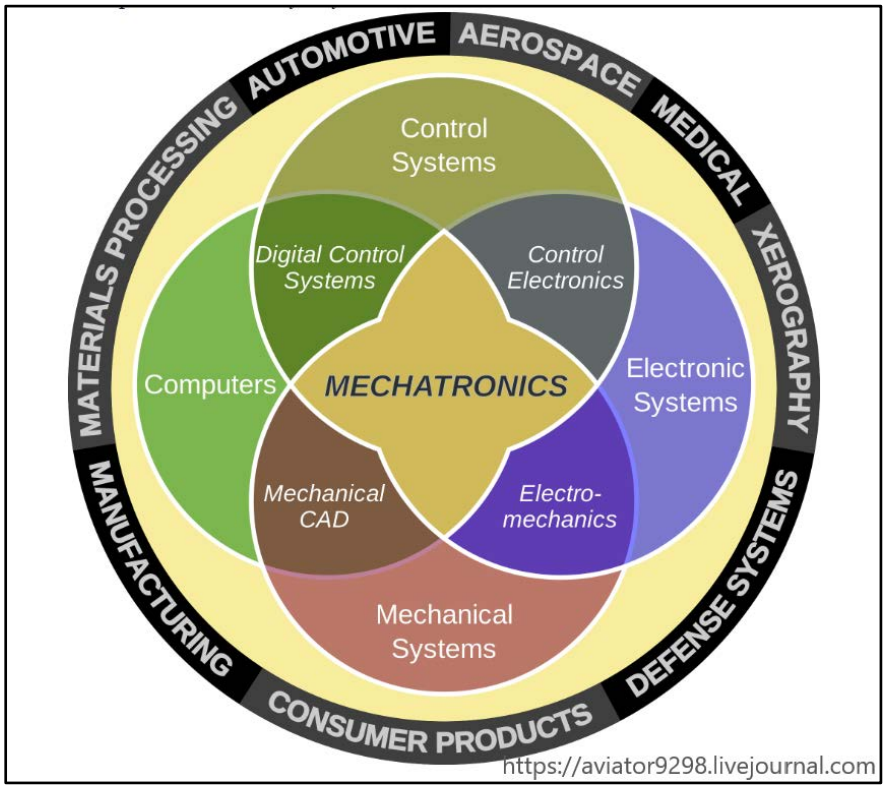

Рис. 1.4. На диаграмме Эйлера с веб-сайта RPI представлены области, из которых состоит мехатроника

5. Прочитайте и переведите текст 6A письменно со словарем:

TEXT 6A

Мехатро́ника — область науки и техники, основанная на синергетическом объединении узлов точной механики с электронными, электротехническими и компьютерными компонентами, обеспечивающими проектирование и производство качественно новых механизмов, машин и систем с интеллектуальным управлением их функциональными движениями. Простыми словами, мехатроника - это сочетание робототехники, электроники, информатики, телекоммуникаций, систем управления и разработки продуктов.

6. Составьте реферат текста, используя план из упражнения 6 Unit 1.

UNIT 7

ПРОГРАММИРОВАНИЕ МЕХАТРОННЫХ СИСТЕМ И КОМПЛЕКСОВ

1. Изучите следующие слова и выражения:

1. *adjustment – регулировка; настройка; согласование*
2. *advantage – преимущество; выгода, польза*
3. *to alter – изменять(ся); переделывать*
4. *cam – кулачок; выступ на(распределительном) валу*
5. *capability – способность*
6. *capacity – возможность; способность*
7. *circumstance – обстоятельство; условие*
8. *consideration – рассмотрение, обсуждение; внимание; to take into consideration – принимать во внимание; considerable – значительный; важный*
9. *content – содержание; содержимое*
10. *to convert – преобразовывать*
11. *decision – решение; to make a decision – принимать решение*
12. *deviation – отклонение*
13. *error – ошибка; погрешность*
14. *to exert – осуществлять*
15. *fashion – образ; форма, вид; стиль*
16. *to flip – перебрасывать(ся)*
17. *to improve – улучшать(ся); совершенствовать(ся)*
18. *to involve – включать в себя; влечь за собой*
19. *linkage – сцепление; соединение*
20. *means – способ; средство; средства*
21. *monitoring – слежение, контроль, мониторинг*
22. *proper – правильный; подходящий; должный; properly – правильно; должным образом*
23. *to provide for – предусматривать; to provide with – снабжать; обеспечивать*
24. *raw – сырой, необработанный, неочищенный*
25. *recovery – восстановление; возврат (к заданному значению)*
26. *to relate – относиться*
27. *to respond – отвечать; реагировать*
28. *response – ответ*
29. *safety – безопасность; надёжность*
30. *to sophisticate – усложнять*
31. *to specify – устанавливать; указывать; определять*
32. *to store – запоминать, хранить; storage – запоминание, хранение; память*
33. *to verify – проверять; подтверждать*

2. Прочитайте текст и переведите:

TEXT 7

MACHINE PROGRAMMING

The programmed instructions determine the set of actions that is to be accomplished automatically by the system. The program specifies what the automated system should do and how its various components must function in order to accomplish the desired result. The content of the program varies considerably from one system to the next. In relatively simple systems the program consists of a limited number of well-defined actions that are performed continuously and repeatedly in the proper sequence with no deviation from one cycle to the next. In more complex systems the number of commands could be quite large, and the level of detail in each command could be significantly greater. In relatively sophisticated systems the program provides for the sequence of actions to be altered in response to variations in raw materials or other operating conditions.

Programming commands are related to feedback control in an automated system in that the program establishes the sequence of values for the inputs (set points) of the various feedback control loops that make up the automated system. A given programming command may specify the set point for the feedback loop, which in turn controls some action that the system is to accomplish. In effect, the purpose of the feedback loop is to verify that the programmed step has been carried out. For example, in a robot controller the program might specify that the arm is to move to a designated position, and the feedback control system is used to verify that the move has been correctly made.

Some of the programmed commands may be executed in a simple open-loop fashion – i.e., without the need for a feedback loop to verify that the command has been properly carried out. For example, a command to flip an electrical switch may not require feedback. The need for feedback control in an automated system might arise when there are variations in the raw materials being fed into a production process, and the system must take these variations into consideration by making adjustments in its controlled actions. Without feedback the system would be unable to exert sufficient control over the quality of the process output.

The programmed commands may be contained on mechanical devices (e.g., mechanical cams and linkages), punched paper tapes, magnetic tapes, magnetic disks, computer memory, or any of a variety of other media that have been developed over the years for particular applications. It is common today for automated equipment to use computer storage technology as the means for storing the programmed commands and converting them into controlled actions. One of the advantages of computer storage is that the program can be readily changed or improved. Altering a program that is contained on mechanical cams involves considerable work.

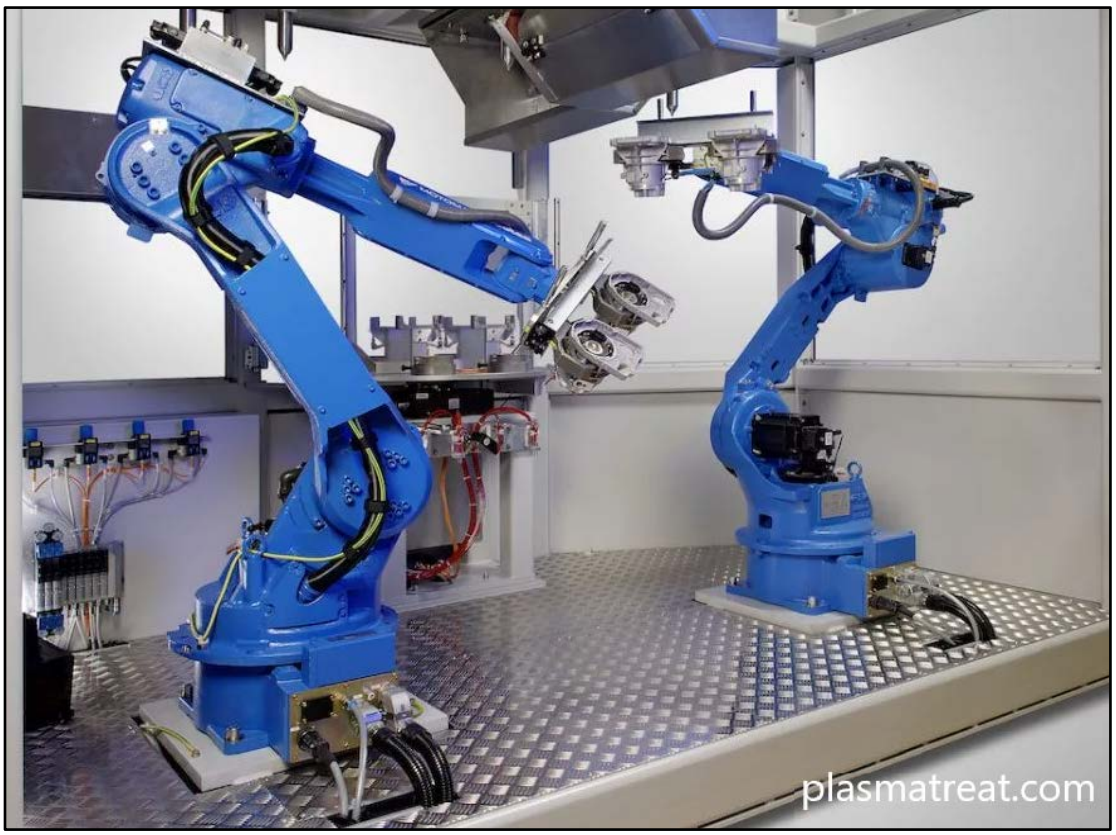

Рис. 1.5. Промышленный робот-манипулятор

Programmable machines are often capable of making decisions during their operation. The decision-making capacity is contained in the control program in the form of logical instructions that govern the operation of such a system under varying circumstances. Under one set of circumstances the system responds one way; under different circumstances it responds in another way. There are several reasons for providing an automated system with decision-making capability, including (1) error detection and recovery, (2) safety monitoring, (3) interaction with humans, and (4) process optimization.

3. Переведите предложения на английский язык:

1. Автоматизированная система осуществляет набор действий, определяемых программой.
2. В простых системах программа включает ограниченное число действий, в сложных системах число запрограммированных команд гораздо больше.
3. В автоматизированной системе запрограммированные команды связаны с управлением с обратной связью.
4. Цель управления с обратной связью – проверить точное выполнение запрограммированной операции.
5. Запрограммированные команды могут содержаться на механических устройствах, перфолентах, магнитных лентах и магнитных дисках.

6. Автоматизированное оборудование использует технологию компьютерной памяти.

7. Программируемые машины способны принимать решения во время своей работы.

8. Способность принимать решения заключается в управляющей программе в форме логических команд.

4. Ответьте на следующие вопросы:

1. What is a programmed instruction?
2. What is a program?
3. Does the content of the program vary from one system to another? Why?
4. What kinds of media may contain the programmed commands?
5. What is the decision-making capacity of programmable machines?

5. Составьте реферат текста, используя план из упражнения 6 Unit 1.

UNIT 8

КОМПЬЮТЕРНОЕ УПРАВЛЕНИЕ ТЕХНОЛОГИЧЕСКИМ ПРОЦЕССОМ

1. Изучите следующие слова и выражения:

1. actuation – приведение в действие
2. alarm – аварийный сигнал
3. to facilitate – содействовать; облегчать; facility –устройство; facilities – оборудование; аппаратура
4. furnace – печь; горн; топка
5. handling – управление, манипулирование; загрузка-разгрузка; транспортировка
6. horn – рожок
7. to implement – осуществлять, выполнять; внедрять
8. to maintain – обслуживать
9. message –сообщение
10. to process – обрабатывать; processing – обработка; process – (технологический) процесс; process industry – обрабатывающая промышленность
11. rate – скорость; интенсивность
12. sampling – апробирование; выборочный контроль; sample – образец; проба; выборка
13. valve – клапан; распределитель
14. variable – переменная величина
15. yield – объём выпуска; производительность; эффективность.

2. Закончите предложения подходящим вариантом:

1. In computer process control the purpose of digital computer is …
   a) to store the programmed commands.
   b) to direct the operations of a manufacturing process.

2. The modern computer process control system can measure…
   a) temperature, flow rate, and pressure.
   b) the productivity of a process plant.

3. The typical modern process plant is…
   a) computer-controlled.
   b) mechanized.

4. All computers of the plant are connected to the central computer…
   a) in a random order.
   b) in a hierarchical configuration.

5. Each process computer monitors the parameters that are required…
   a) to control the central computer.
   b) to control the process of manufacturing.

6. The central computer is able to…
   a) integrate all the data from the process computers.
   b) process data in numerical form.

3. Прочитайте журнальную заметку и выберите подходящее название. Объясните свой выбор:

TEXT 8

a) CONTROL ALGORITHMS
b) COMPUTER PROCESS CONTROL
c) MANUFACTURING PROCESS

In computer process control a digital computer is used to direct the operations of a manufacturing process. Although other automated systems are typically controlled by computer, the term “computer process control” is generally associated with continuous or semi-continuous production operations involving materials such as chemicals, petroleum, foods, and certain basic metals. In these operations the products are typically processed in gas, liquid, or powder form to facilitate the flow of the material through various steps of the production cycle. In addition, these products are usually mass-produced. Because of the ease of handling the product and the large volumes involved, a high level of automation has been accomplished in these industries.

The modern computer process control system generally includes the following: (1) measurement of important process variables such as temperature, flow rate, and pressure; (2) execution of some optimizing strategy; (3) actuation of such devices as valves, switches, and furnaces that enable the process to implement the optimal strategy; and (4) generation of reports to management indicating equipment status, production performance, and product quality. Today computer process control is applied to many industrial operations, two of which are described below.

The typical modern process plant is computer-controlled. In one petrochemical plant that produces more than 20 products, the facility is divided into three areas, each with several chemical-processing units. Each area has its own process-control computer to perform scanning, control, and alarm functions. The computers are connected to the central computer in a hierarchical configuration. The central computer calculates how to obtain maximum yield from each process and generates management reports on the process performance.

Each process computer monitors up to 2,000 parameters that are required to control the process, such as temperature, flow rate, pressure, liquid level, and chemical concentration. These measurements are taken on a sampling basis; the time between samples varies between 2 and 120 seconds, depending on the relative need for the data. Each computer controls approximately 400 feedback control loops. Under the normal operation each control computer maintains the operation of its process at or near optimum performance levels. If process parameters exceed the specified normal or safe ranges, the control computer actuates a signal light and an alarm horn and prints a message indicating the nature of the problem for the technician. The central computer receives the data from the process computers and performs calculations to optimize the performance of each chemical-processing unit. The results of these calculations are then passed to the individual process computers in the form of changes in the set points for various control loops.

Substantial economic advantages are obtained from this type of computer control in the process industries. The computer hierarchy is capable of integrating all the data from many individual control loops far better than humans are able to do, thus permitting a higher level of performance. Advanced control algorithms can be applied by the computer to optimize the process. In addition, the computer is capable of sensing the process conditions that indicate the unsafe or abnormal operation much more quickly than humans can. All these improvements increase productivity, efficiency, and safety during the process operation.

4. Ответьте на следующие вопросы:

1. What is a “computer process control”?
2. What does the modern computer process control system generally include?

ТЕКСТ ДЛЯ САМОСТОЯТЕЛЬНОЙ РАБОТЫ СТУДЕНТА
CONTROL AND SEQUENCE OR SYSTEM STATE CONTROL

Sequential control may be either to a fixed sequence or to a logical one that will perform different actions depending on various system states. An example of an adjustable but otherwise fixed sequence is a timer on a lawn sprinkler.

States refer to the various conditions that can occur in a use or sequence scenario of the system. An example is an elevator, which uses logic based on the system state to perform certain actions in response to its state and operator input. For example, if the operator presses the floor n-button, the system will respond depending on whether the elevator is stopped or moving, going up or down, or if the door is open or closed, and other conditions.

An early development of sequential control was relay logic, by which electrical relays engage electrical contacts which either start or interrupt power to a device. Relays were first used in telegraph networks before being developed for controlling other devices, such as when starting and stopping industrial-sized electric motors or opening and closing solenoid valves.

Using relays for control purposes allowed event-driven control, where actions could be triggered out of sequence, in response to external events. These were more flexible in their response than the rigid single-sequence cam timers. More complicated examples involved maintaining safe sequences for devices such as swing bridge controls, where a lock bolt needed to be disengaged before the bridge could be moved, and the lock bolt could not be released until the safety gates had already been closed.

The total number of relays, cam timers and drum sequencers can number into the hundreds or even thousands in some factories. Early programming techniques and languages were needed to make such systems manageable, one of the first being ladder logic, where diagrams of the interconnected relays resembled the rungs of a ladder. Special computers called programmable logic controllers were later designed to replace these collections of hardware with a single, more easily re-programmed unit.

In a typical hard wired motor start and stop circuit (called a control circuit) a motor is started by pushing a "Start" or "Run" button that activates a pair of electrical relays. The "lock-in" relay locks in contacts that keep the control circuit energized when the push button is released. (The start button is a normally open contact and the stop button is normally closed contact.) Another relay energizes a switch that powers the device that throws the motor starter switch (three sets of contacts for three phase industrial power) in the main power circuit. (Note: Large motors use high voltage and experience high in-rush current, making speed important in making and breaking contact. This can be dangerous for personnel and property with manual switches.) All contacts are held engaged by their respective electromagnets until a "stop" or "off" button is pressed, which de-energizes the lock in relay. Commonly interlocks are added to a control circuit. Suppose that the motor in the example is powering machinery that has a critical need for lubrication. In this case an interlock could be

added to insure that the oil pump is running before the motor starts. Timers, limit switches and electric eyes are other common elements in control circuits.

Solenoid valves are widely used on compressed air or hydraulic fluid for powering actuators on mechanical components. While motors are used to supply continuous rotary motion, actuators are typically a better choice for intermittently creating a limited range of movement for a mechanical component, such as moving various mechanical arms, opening or closing valves, raising heavy press rolls, applying pressure to presses.

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ОГЛАВЛЕНИЕ

АВТОМАТИЗИРОВАННОЕ ПРОИЗВОДСТВО

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Часть 1

Составители:
Аленькова Наталья Валерьевна
Полухина Ирина Васильевна
Прибыткова Ольга Васильевна
Малютина Юлия Владимировна

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Компьютерный набор Н. В. Аленьковой

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ФГБОУ ВО «Воронежский государственный технический университет»
394006 Воронеж, ул. 20-летия Октября, 84